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STUDY PROJECT

ACCESS TO MANGANESE IN THE YEAR 2005

BY

Lieutenant Colonel Edward J. Fitzgerald
United States Army

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For decades the United States has treated manganese as a strategic mineral. Its uses are, and have been, crucial to our military and economic survival. This need, combined with the fact that the United States does not have any natural reserves of its own, makes it technically a strategic mineral. The purpose of this paper is to examine the primary uses of manganese, the locations of its abundant available reserves, and ultimately to determine the courses of action the United States should take in the future to ensure access to this strategic mineral in the year 2005. Mineral source locations researched include the former Soviet Union, Gabon, Republic of South Africa, and the Republic of Brazil. These countries control the majority of the world reserves. They are examined by comparing their historical prejudices and current internal situation with their country's long term survival needs to supply the United States and the world with manganese. Additionally, the abundant source of manganese nodules, are scrutinized as the possible future abundant economic source for the United States. The analysis of aforementioned information results in a recommendation that ensure the uninhabited access of

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ACCESS TO MANGANESE IN THE YEAR 2005

AN INDIVIDUAL STUDY PROJECT

by

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For decades the United States has treated manganese as a strategic mineral. Its uses are, and have been, crucial to our military and economic survival. This need, combined with the fact that the United States does not have any natural reserves of its own, makes it technically a strategic mineral. The purpose of this paper is to examine the primary uses of manganese, the locations of its abundant available reserves, and ultimately to determine the courses of action the United States should take in the future to ensure access to this strategic mineral in the year 2005. Mineral source locations researched include the former Soviet Union, Gabon, Republic of South Africa, and the Republic of Brazil. These countries control the majority of the world reserves. They are examined by comparing their historical prejudices and current internal situation with their country's long term survival needs to supply the United States and the world with manganese. Additionally, the abundant source of manganese nodules, are scrutinized as the possible future abundant economic source for the United States. The analysis of aforementioned information results in a recommendation that ensures the uninhabited access of the United States to the strategic mineral, manganese.

Purpose:

In September, 1980 the President of the American Geological Institute, Grover E. Murray stated, "Without manganese, chromium, platinum, and cobalt, there can be no automobiles, no airplanes, no jet engines, no satellites, and no sophisticated weapons - not even home appliances."[1] Of these four, manganese is probably the least discussed and least understood. The purpose of this paper is to examine the vital strategic metal manganese in the year 2005, from what are the currently abundant and economically feasible supplies to what the situation is likely to be in the future.

What Is Manganese?

Manganese is a silvery, brittle metallic element that is the twelfth most common element in the earth's crust.[2] It was isolated in 1774 by J.G. Gann.[3] Before that time, the principal use of manganese was for the control and production of color in glass and pottery.[4] Its application in the production of steel dates from 1839, when manganese was found to improve the malleability of ferrous articles.[5] Almost all of the current production of manganese is consumed by the iron and steel industry where it is combined with sulphur to produce a manganese sulphide slag that is easily separated from steel.[6] It is as a desulphuriser and a deoxidiser that it has attained its most important and irreplaceable use. However, the shift away from the basic Bessemer steel making processes toward hybrid processes called the electric, basic oxygen and Q Bo P type have reduced the average manganese consumption per ton of

steel produced from 10.4kg. (when only the Bessemer process was used) to the present estimate of 6.5kg.[7] Manganese is also used as an alloy in the production of specialty steel products. It adds strength and hardness to aluminum. When it is alloyed with copper it forms manganese bronzes, and it adds hardness and corrosion resistance to magnesium.[8]

Other uses of maganese include manganese dioxides for dry cell batteries, production of hydroquinone (used in photographic developers and in the production of rubbers and plastics), leaching uranium ores, electrolytic production of zinc, and additives to animal feeds and fertilizers.[9]

The percentage of general end uses of manganese in 1990 were construction, 32%; machinery, 15%; transportation, 14%; and other uses, 39%.[10] Even with current technological advances there is no known satisfactory substitute for manganese in the production of iron and steel. There are some substitutes for its other uses.[11]

Reserve Versus Resource:

The basic difference between a reserve and a resource is economics. When a source is available, but the establishment of the required infrastructure and technology to mine and get the material to the production plant is uneconomical, it is a resource.[12] Reserves are those materials that are economically retrievable when compared to a resource.[13] The official definitions of a resource, reserve, and reserve base, according to the U.S. Department of the Interior Bureau of Mines, are as follows:

> Resource.- A concentration of naturally occurring solid, liquid, or gaseous material in or on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.[14]

> Reserves.- That part of the reserve base which could be economically extracted or produced at the time of determination. The term reserves need not signify that extraction facilities are in place and operative. Reserves include only recoverable materials; thus terms such as "extractable reserves" and "recoverable reserves" are redundant and are not a part of this classification system.[15]

> Reserve Base.- That part of an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality, thickness, and depth. The reserve base is the in-place demonstrated (measured plus indicated) resource from which reserves are estimated. It may encompass those parts of the resources that have a reasonable potential for becoming economically available within planning horizons beyond those that assume proven technology and current economics. The reserve base includes these resources that are currently economic (reserves), marginally economic (marginal reserves), and some of those that are currently sub economic (sub economic resources).[16]

Manganese is one of the most abundant elements in the earth's crust. World reserves of manganese in 1983 were estimated as one billion tons of manganese content.[17] This quantity of reserves was about five times as great as the highest forecast of the years 1983-2000 cumulative world demand.[18] With this much excess supply, the question then becomes "Where are these manganese reserves located?" The concern for the United States is whether the countries

that control the reserves will continue to allow us access to their abundant supplies.

Manganese As A Reserve:

Manganese is the cheapest of the metallic elements used to alloy with iron.[19] Manganese ore prices vary depending upon chemical analysis, physical characteristics, and their intended use. An example is battery ore that may sell for several times as much as metallurgical ore with a comparable manganese content.[20] Metallurgical ore, using 1983 constant dollars, fluctuated from $2.44 per long ton in 1963 to $1.24 in 1969, to $2.37 in 1975, to $1.38 in 1983.[21] The average price for 1991, using 1991 dollars, was $3.95 per short ton.[22] These price variances are due to inflation and the sporadic access to Brazil's, Republic of South Africa's, and other world reserves. Notwithstanding though, manganese is a relatively cheap metal, which is consistent with its availability.

The United States, Japan, and Western Europe are all nearly deficient in manganese that is economically minable.[23] The following chart depicts the manganese status from 1986 to1990 for the United States:

Statistics - United States	1986	1987	1988	1989	1990
Production, mine:	0	0	0	0	0
Imports for consumption:					
Manganese Ore-	463	341	512	639	300
Ferromanganese-	396	368	531	476	440

Continued on next page

Statistics - United States	1986	1987	1988	1989	1990
Exports:					
Manganese ore-	42	63	68	57	50
Ferromanganese-	4	3	3	9	5
Shipments from Government Stockpile excesses:					
Manganese ore-	150	228	78	78	179
Ferromanganese-	81	0	52	55	56
Consumption, reported					
Manganese ore-	500	533	554	616	580
Ferromanganese-	376	409	468	440	435
Consumption, apparent, manganese:	730	699	752	797	750
Price, average value, 46% - 48% MN metallurgical ore, dollars per ltu cont, MN c.i.f. US ports:	1.34	1.29	1.78	2.80	3.95
Stocks, producer and consumer, yearend:					
Manganese ore-	455	456	458	518	465
Ferromanganese-	93	48	91	75	50
Net import reliance as a percent of apparent consumption:	100	100	100	100	100

Source: Mineral Commodity Summaries, 1991.

While the U.S. exported 55 thousand short tons (recycled, low grade, or stockpile excesses), the significant statistic from this chart is that the U.S. was ultimately reliant on imports for 740 thousand short tons consumed in 1990.[24] The countries that have the huge reserves for the U.S. to draw upon include: Australia, Brazil, Gabon,

India, Mexico, Republic of South Africa, China, and the former USSR.[25] More on this later.

Manganese As A Resource:

Identified land-based manganese resources are quite large, but are very irregularly distributed. The former USSR and the Republic of South Africa account for more than 80% of the world's identified resources, while the Republic of South Africa accounts for more than 80% of the manganese purchased by the established market economy countries.[26]

An additional untapped resource is available though, manganese nodules from the ocean floor. In the 1870s, the H.M.S. Challenger conducted a scientific expedition to collect ocean samples.[27] These efforts produced potato shaped particles approximately four inches in diameter. Analysis showed these nodules to contain 30 elements[28], of which on average 30% consisted of manganese.[29] The samples drew little interest, but were kept in a British museum's archives for the next eighty years.[30] In 1952, the possible transformation of manganese nodules from scientific curiosity to a valuable resource was fully grasped by a scientist named John L. Mero.[31] The possibility of changing the nodules from a resource to a reserve has been debated ever since.

The essential reason for global interest in the nodules resides in their abundance. They have been found in all the earth's oceans (even in some lakes), and estimates on their aggregate weight run into the trillions of tons.[32] The study by John L. Mero claims that

there are approximately 1.5 trillion tons of nodules in the Pacific Ocean alone.[33] It has also been estimated that 80 to 90 percent of the nodules lie on the seabed beyond even the furthest claims to national jurisdiction (i.e., 200 miles from land).[34]

In 1981 the U.S. Representative from Hawaii stated the following to the American Mining Conference in response to the legal concerns over mining the nodules:

> Fifteen months ago, the "Deep Seabead Hard Mineral Resources Act of 1980" became law. That Act, Public Law 96-283, is based on the declared finding of Congress that, and I quote: "The future national interest of the United States requires the availability of hard mineral resources which is independent of the export policies of foreign nations." The Act further recognizes deep seabed nodules as an alternative source supply significant both to national and to international needs, and provides for a system under which U.S. citizens could obtain a license to explore and mine the deep seabed.
>
> That Act contains three other important features. First, it provides that if other nations would recognize an U.S. license to mine within specified areas, we in turn would recognize theirs. Second, the U.S. government is authorized to negotiate agreements with other nations with similar legislation to provide for reciprocal recognition of licenses and mining areas, and for a system to resolve conflicts between overlapping applications. Third a very important feature of the Act provides that U.S. companies operations under U.S. legislation should be grandfathered into any future law of the Sea Treaty to which the U.S. becomes a party.[35]

Another impetus for passing this legislation was the revitalized concern over the Soviet threat by President Reagan and the status of

our strategic stockpiles. As stated by Paul K. Kruegar of the Federal Emergency Management Agency in 1981:

> On March 13, 1981, President Reagon directed FEMA to begin the first purchase program for the stockpile in over 20 years. The President said that "This acquisition program is a necessary first step" and that larger purchases are expected to be made as funds from sales of excess materials build up in the stockpile fund. The Congress appropriated $100 million for stockpile purchases for each of fiscal years 1981 and 1982. Authorizations for disposals in the amount of approximately $2 billion have been appropriated.[36]

While many inroads have been made in the discovery of manganese nodules and passing legislation to allow them to be mined, cost is still the overriding issue. The cost for prospecting, exploring, research and development, prototype development, and commercial exploitation is estimated to be 750 million dollars.[37] The commercial exploitation cost alone is estimated to be 600 million dollars.[38] From these costs one can readily see why the nodules are considered a resource.

Is Manganese A Strategic Mineral?

Originally the word "strategic" meant essential to effective military strategy.[39] With the passage of Section 12 (1) of the United States Strategic and Critical Materials Stock Piling Act (50 U.S.C. 98 et seq.) the following definition of strategic materials was provided.

> The term "strategic and critical materials" means materials that:

(A) Would be needed to supply the military, industrial, and essential civilian needs of the United States during a national emergency, and

(B) Are not found or produced in the United States in sufficient quantities to meet such need.[40]

Manganese meets these requirements to be a strategic material (mineral). It was estimated that in 1990 domestic mine production of manganese ore in the United States would be zero while apparent consumption of manganese would be 750,000 tons, content bases.[41] This translates to the United States not having any reserves, other than what is stockpiled, but having a military, industrial, and essential civilian need. Manganese is clearly a strategic mineral.

Where Does The Strategic Mineral Manganese Come From?

Additional improvements in our manganese stockpiles have been made since 1980 when President Reagon renewed the efforts of the United States in upgrading their status. In September 1989, the Defense Logistics Agency (DLA) of the U.S. Department of Defense extended for 2 years the domestic upgrading of metallurgical manganese ore in the stockpile into high-carbon ferromanganese.[42] DLA contracted for conversion of 265,000 tons of ore into about 148,000 tons of ferromanganese, to be done during 1990 and 1991.[43] The following chart depicts the stockpile status of manganese in thousand short tons as of September 30, 1990.

Material (type of manganese)	Goal	Total Inventory	Excess to goal authorized for disposal	Sales 9 months
Battery:				
Natural ore	25	169	76	0
Synthetic dioxide	25	3	0	0
Chemical ore	170	173	0	0
Metalurgical ore	2,700	1,812	0	0
Ferromanganese:				
High-carbon	439	868	0	0
Medium-carbon	0	29	0	0
Silicomanganese	0	24	0	0
Electrolytic metal	0	14	0	0

Source: Mineral Commodity Summaries, 1991.

This chart depicts the manganese stockpile to be at 94% of the total goal. This compared with the 20% fill in 1980 is a dramatic improvement and alleviates much of our need for access to reserves. As stated previously though, Japan, Europe, and the United States do not have reserves and are reliant upon other countries for manganese. The chart below depicts in thousand short tons those countries in 1990 that had major reserves:

Country	Mine Production	Reserves	Reserve Base
United States	0	0	0
Australia	2,300	44,000	170,000
Brazil	1,900	23,000	65,000
China	3,100	15,000	32,000

Continued on next page

Country	Mine Production	Reserve	Reserve Base
Gabon	2,800	58,000	180,000
India	1,400	19,000	28,000
Mexico	430	4,000	10,000
Republic of South Africa	4,100	407,000	2,900,000
Former U.S.S.R.	9,500	325,000	500,000
Other countries	750	Small	Small
World total (rounded)	26,300	900,000	3,900,000

Source: Mineral Commodity Summaries, 1991.

This chart demonstrates the abundance of manganese reserves in the world. Again though, we have to remind ourselves that the United States, Japan, and Europe do not have their own reserves and are reliant upon the listed countries for their manganese.

An excellent example of why manganese is still a strategic metal, even though it is abundant, was given a decade ago by Congressman Jim Santini. He described the US dependence on southern Africa as follows:

> The US is dependent on southern Africa for approximately three-fourths of its supply of manganese, cobalt and chrome. If the Soviet Union knocks off Zaire, if Zimbabwe goes down the drain - Zambia is already a Marxist State - and if South Africa has a racial revolution or invasion or both, Russia will control 80% of the market place of these three strategic minerals.[44]

Soviet Union/Commonwealth of Independent States Influence:

The dissolution of the USSR at the end of 1991 and emergence of the CIS has not yet improved our access to information on their mineral production and trade data. The reasons for lack of improvement are diverse, and vary on one's point of view. Many believe that the economic damage and human loss caused by the earthquake in Armenia in 1988 forced the central government to depart temporarily from their new economic reforms.[45]

Ineptness at economically using the nation's resources was voiced by V. Dolgikh, a candidate member of the old Politburo. He stated "what is the use of increasing output in the raw materials and fuel and energy sectors if the increase is eaten up because of the irrational, wasteful use of resources. A further tilt in this direction imposes a very heavy burden on the economy."[46] Another frustration was voiced in an article in the Sotsialisticheskaya Industriya (Socialist Industry). It stated, "one of our favorite spheres of secrecy is our resources...it is clear how little logic there is in protecting the contents and volume of stocks of minerals. Who will steal them? And who is interested if we take 15 to 20 years to develop them using our own efforts?"[47]

The inability of the old Soviet system to efficiently mine and move their materials to the production sectors resulted in the formation of the Glavalmazzoloto (Main Diamond and Gold Directorate). The new directorate was given control of all mining enterprises, ore and metal processing plants, secondary processing plants, finished-goods and jewelry making plants, and scientific research and auxiliary organizations supporting these activities.[48] The directorate took its mandate and made many inroads over the next few years.

Dramatic progress was made, but most involved countries affiliated with the former Soviet Union, rather that focusing internally on improving the efficient use of their own internal assets. In 1988, 191 joint ventures with foreign organizations were negotiated.[49] Tremendous efforts on geological and oil prospecting expeditions were expended in South Yemen, Ethiopia, Cuba, Afghanistan, Guinea, Nicaragua, Mozambique, Algeria, Vietnam, North Korea, Malaysia, Ghana, Angola, and Brazil.[50] In 1991, with the dissolution of the Soviet Union, disarray again prevailed. This disarray has also prevented other countries from buying their exports.

The military, political, and economic influence of the old Soviet Union, as we knew it for decades, has disappeared. The focus of the new Commonwealth of Independent States is on their internal problems and currently they have little interest in affecting third world countries. The previous concerns of Congressman Jim Santini no longer hold credence. This has left a void that will eventually be filled. Looking at the current economic powers it may be Japan or the newly formed European Community.

Why Should The U.S. Focus On South Africa, Gabon, And Brazil For It's Future Manganese?

Very simply, these three countries have the required large reserves to continue meeting our demands through the year 2005. Additionally, while Gabon and the Republic of South Africa did no have formal ties with the former Soviet Union, Brazil did. A window of opportunity to improve ties between the United States and Brazil is now available. Lastly, these countries are located on two different

continents, providing the United States a form of diversification. Now let's look at each country in more detail.

Republic Of South Africa:

The Republic of South Africa is the southernmost state on the African continent. It has an area of 471,447 square miles[51] and over sixteen million inhabitants.[52] Its terrain varies from sea level to 8,000 feet with predominantly a subarid climate.[53] Its immense natural resources, coupled with control of the Cape of Good Hope, makes this country one of the most strategically important countries of Africa.

Republic Of South Africa History:

The Republic of South Africa was discovered in 1498 by Vasco da Gama from Portugal as he attempted to round the Cape and begin trade with India.[54] While the Portuguese gained maritime supremacy in the Indian Ocean, they never established settlements in South Africa. It was the Dutch and English, in the 16th century, that established the initial settlements. The Netherlands in 1687, were the first to be convinced of the true importance of South Africa when they established a rest station in vicinity of the Cape to reek the monetary rewards from the ships enroute to Asia and India.[55] Thus began the introduction of whites to South Africa setting the initial stage for Apartheid.

During the European Wars, following the French Revolution, Cape Province in 1795 was taken from the Dutch by the British. It was

finally ceded to the British in 1814 by a peace settlement.[56] The latter part of 19th century was dominated by friction between the British government and the English and other European immigrants and the Dutch or Afrikaner republics.[57] Thus began the separation of South Africa from British control.

South Africa became a unitary state on May 31, 1910. It was initially governed under the South Africa Act of 1909, which was drawn up by representatives of the four self-governing colonies, the Cape of Good Hope, Natal, the Orange Free State, and Transvaal, and passed by the British Parliament.[58] This act formed the basis for the South African constitution when it became a republic on May 31, 1961.[59]

Whites, African, Coloured, And Asian:

There are four racial groups recognized by South African law. The whites are subdivided into Afrikaners, the descendants of Dutch, French, and German forbearers, and the white English speaking group. The Africans are the tribal descendants of South Africa. The Coloured are the result of inbreeding between the Africans and peoples of other descent. The Asians are predominately Indians who live in Natal Province. Non-whites outnumber whites by six to one.[60]

The 1909 constitution established limited participation in the political system by Africans, Coloured, and Asians. These rights dwindled away over the decades and in 1968, the Political Interference Act declared that only whites could participate in white political parties.[61] Hence, the birth of Apartheid and the displeasure of the democratic nations.

The Republic of South Africa established a homeland policy. Its goal was the exclusion of persons of color from the more important decision-making processes.[62] This policy also allowed the multi-national society to determine national independence. Many nations did in fact split from the Republic of South Africa, leaving the Whites controlling and owning the majority of the reserves and resources of the state.

The Republic of South Africa Economy:

Manganese is an important export for South Africa, but their economy is far from dependent on it. Diamonds and gold are their primary mineral exports, of which their profits have dramatically provided the necessary wealth to introduce modern systems of transportation and communication.[63] The economic sanctions and subsequent isolation, due to their Apartheid philosophy, is what has had the greatest detrimental effect over the last few decades. The apparent current change in their philosophy toward the majority of their population may cause an easing of those sanctions. Even with the current sanctions, the gross domestic product has increased by about 7% annually.[64]

The Future Of The Republic Of South Africa:

South Africa is a rich country that has been controlled for centuries by the minority, the whites. This supremacy policy is slowly changing, but certainly will not change the richness and strategic

importance of this country. Only the players that the United States deals with will change.

Gabon:

Gabon is a country in central Africa that straddles the equator on the west coast of Africa. It has an area of 103,347 square miles and over 1.4 million inhabitants.[65] Its population growth rate of 0.6% is among the lowest in Africa.[66] Its terrain varies from sea level to 5,200 feet[67] with predominately forested land. It is the least populated, but the most mineral rich country to emerge out of French Equatorial Africa.[68]

Gabon History:

Gabon was discovered in the last half of the 15th century when Portuguese navigators reached the Gabon Estuary.[69] The Mpongwe, a tribe that came into the Gabon area as late as the 13th century, were the first inhabitants that they came into contact with.[70] The Fang, a tribe that came into the Gabon area in the beginning of the 19th century, eventually destroyed the Mpongwe people, and are presently the dominant ethnic group in Gabon's modern social, economic, and political life.[71]

During the 18th and 19th centuries, the Netherlands, Britain, America, and France searched the Gabonese coast for slaves, wood, rubber, adventure, and opportunities to make converts to Christianity.[72] The French were the driving force in Gabon's commerce as a treaty was signed in 1843 with the Mpongwe ruler

for trade, protection, territorial cession and even blockhouses for slaves.[73]

French control of Gabon was widely regarded as the worst of the French colonies by both Europeans and Africans who worked there.[74] This did not change until after World War II when Charles de Gaulle made dramatic moves toward a more liberal direction in French colonial policy.[75]

In 1946 Gabon was given the status of an overseas territory of France and in 1958 became a self-governing republic with the French Community.[76] Finally, in 1961, Gabon was given independence and elected its first president.[77] Since 1968 the government of Gabon has been stable with the Fang ethnic group having the majority of the power.[78]

Gabon's Economy:

Mining is the mainstay for Gabon's exports. 90% of its exports consist of petroleum, manganese, uranium, and thorium ores and concentrates. Gabon is the world's third largest producer of manganese, outranked only by the Commonwealth of Independent States and South Africa. Reserves are estimated at 200 million tons and are expected to last 150 years.[79]

Until the 1960s the economy of Gabon was principally the cultivation of its extensive forests. The rapid discovery, development, and production of its other natural resources has placed Gabon's gross national product per capita as one of the richest in Africa, south of the Sahara.[80]

The Future Of Gabon:

Gabon is, and for the foreseeable future, a stable country. The general populace is content with their government. While it controls the news media and only provides one party to elect officials from, the high per capita and social welfare system which provides benefits to employed persons for work injury, maternity, disability, and old age offsets the dictatorial type government. One can only assume that between contented citizens and unlimited natural resources that Gabon will remain stable.

Brazil:

Brazil, officially the Federal Republic of Brazil, is the largest and most populated country in South America. It occupies the eastern half of the continent with an area of 3,286,488 square miles.[81] and 155 million inhabitants.[82] Its terrain varies from sea level to 9,482 feet with predominately a tropical climate.[83] 67% of the land is covered by forests and therefor one of their primary exports is timber. This has arisen as the main dispute with the international community, the environmental effects of the deforestation of the Amazon basin.

Federal Republic Of Brazil History:

Brazil was discovered by Pedro Alvares Cabral in 1500 and subsequently claimed the land for Portugal.[84] During the next 150 years France and the Netherlands tried to conquer and settle parts of Brazil, but were ultimately unsuccessful.[85]

Portugal initially had little interest in Brazil as its primary focus was on colonial expansion in Africa and India. Finally, in 1533 the Portuguese crown established a system of donatary, a system of lord proprietors over the lands.[86] In 1549 Portugal appointed a governor general to oversee the lords to regain control of Brazil's resources. [87] This system remained in effect until the 18th century.

Slaves from Africa were critical to the lords as they provided the required manpower to pull the resources from the land. A network of slave ships, sailors, slave traders, and a white landowner aristocracy arouse with one of the offsets being racial mixture. With the discovery around 1700 of gold and diamonds, Brazil completed the 18th century as one of the largest colonies in the world.[88]

Brazil won independence from Portugal in 1822 with Peter I establishing a constitution after being crowned emperor.[89] The Peter dynasty remained in power until 1889 when the country was declared a republic.[90] During the next century the military played the deciding role in who would be president as well as what the constitution would contain. Finally, in 1988 a democratic civilian government was put into power through free elections.[91]

Brazil's Relations With The United States:

Even with a civilian run democratic government in place, the military is till outspoken and retains much of its former power. Contained in the Foreign Broadcast Information Service Daily Report of February 6, 1992 was an interview with Brigadier General Thamaturgo Sotero Vaz, former Chief of Staff of the Amazon Command. The main theme was "Waiting for War." He stated:

> The Americans invaded Grenada, moved into Panama to seize a president, and united half the world against Saddam Husayn. All in the name of a supposed justice and world order. From the United Nations the United States received support for all those war operations. Imagine what would happen if tomorrow they started saying up there that the Brazilians were massacring the Ianomani people. Who can guarantee that in the name of human rights, foreign troops will not occupy the Amazon and declare the independence of the Ianomani state? Brazil would be stripped of a territory larger that Portugal. And the whole thing would certainly happen with UN support.[92]

While he was placed in the reserves and stated, "the armed forces think differently now. There is no room for conspiracy or military mutinies. The country's future lies in the ballot box."[93] He also stated "anyone who thinks he has gotten rid of me is very mistaken."[94] This last statement should concern the Brazilian government. His original statement should concern the United States as it depicts the concerns of at least a few powerful people in Brazil.

Brazil's Economy:

Brazil has a developing market economy, based principally upon manufacturing, trade, and financial services.[95] Brazil's rich mineral deposits remain largely unexploited. The principal minerals produced include iron ore, limestone, bauxite, salt, asbestos ore, manganese, kaolin clay, chrome ore barite, zinc ore, gold, diamonds, and quartz crystals.[96] The one strategic material for Brazil is petroleum. The 1973 and 1974 quadrupling of world oil prices

caused them to borrow heavily on the international money markets making them a debtor state to this day.[97] The best overall description of Brazil's economy is contained in the 1991 World Factbook. It states:

> The economy, with large agrarian, mining and manufacturing sector, entered the 1990's with declining real growth, runaway inflation, an unserviceable foreign debt of $122 billion, and a lack of policy direction. In addition, the economy remained highly regulated, inward-looking, and protected by substantial trade and investment barriers. Ownership of major industrial and mining facilities is divided among private interests-including several multinationals and the government. Most large agricultural holdings are private, with the government channeling financing to this sector. Conflicts between large landholders and landless peasants have produced intermittent violence. The government is seeking an IMF standby loan despite several failed agreements over the past decade. Relations with foreign commercial banks remain strained because of mounting interests arrears on Brazil's long term debt. The Collor government, which assumed office in March 1990, is embarked on an ambitious reform program that seeks to modernize and reinvigorate the economy by stabilizing prices, deregulating the economy, and opening it to increased foreign competition. A major long run strength is Brazil's vast natural resources.[98]

Desires and efforts to change Brazil's economy are prevalent throughout the country, but the problems are vast and complex.

The Future Of Brazil:

Brazil has historically been a turbulent country, repeatedly changing governments through coups or populace uprisings. In order

for Brazil to have a bright future the government must remain stable and the foreign debt paid. Both of these are within the ability of the populace to control. The new democracy must control the military and provide better care for the people in order to survive. Secondly, the vast natural resources, particularly in the Amazon, must be efficiently mined and produced to raise money to pay the foreign debt.

If the government does not remain stable, and if the debt is not paid, foreign investment will not occur and the turmoil within Brazil will continue as it has for centuries. The greatest advantage that Brazil currently has is the demise and lack of ability of the former Soviet Union to influence the outcome. For the first time in their history, it is truly up to them.

Manganese In The Year 2005:

There is no current substitute, nor is there one in the foreseeable future, for manganese in the production of iron and steel. However, current manganese reserves in Brazil, South Africa, and Gabon are so abundant that world demand should easily be met. Even if diplomatic relations and economic ties were broken with all three countries, the reserves within the Commonwealth of Independent States, China, India, Australia, and Mexico would meet the world's demands.

Another source that is extremely abundant and able to meet demands, if the entire world stopped exporting manganese, is the nodules from the ocean's floor. These could provide, well into the

next century, a virtually unlimited supply of manganese. At present the one obstacle in mining the nodules is cost. Current prices are too low for the manganese extracted from conventional sources using current technology to allow the nodules to be a viable economic option for obtaining manganese.

Manganese And The United States:

Manganese is a strategic mineral to the United States. We need it, but do not have our own reserves. It is, however, abundantly available in many other countries throughout the world. Therefore, the question for the United States is not will we be able to get manganese, but how much do we have to pay for other country's reserves?

Australia, Mexico, and India already have friendly relations with the U.S. government. Gabon has historically remained neutral, but always showed a desire to export. China and South Africa have had intermittent diplomatic breaks with the United States, but our relations with both are currently improving. Brazil has a new government that is in our best interest to assist, for stability in South America and U.S. economic reasons. The Commonwealth of Independent States is in disarray, but one would have to believe that in a few years they will once again be able to efficiently export their vast minerals. The answers to what the United States should do include: be diplomatic, economically sensible, and make the most of the current world free market.

Free markets are built on supply and demand. We have a demand, and the countries of the world have a supply that far exceeds our demand.

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